CLEAR FLAG AND RESULTS FOR NEAR CLEAR CASES

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CLEAR FLAG

PURPOSES OF CLEAR FLAG

START UP IDENTIFICATION TO DETERMINE CHANNEL FREQUENCIES, SRF'S

SHOULD NOT INVOLVE RADIATIVE TRANSFER CALCULATIONS, RETRIEVALS

SHOULD NOT PRODUCE FALSE CLEAR

% YIELD LESS IMPORTANT

IDENTIFICATION OF CASES TO BE USED BY DATA ASSIMILATORS

SHOULD BE FAST IF DONE FOR REAL TIME USE

FALSE CLEAR CASES SHOULD NOT HAVE LARGE ERRORS

MAXIMIZED YIELDS IS BETTER TO SHOW IMPACT

CLOUD CLEARING

$$R_{I,J} = \left(1 - \sum_K \alpha_{JK}\right) R_{I,CLR} + \sum_K \alpha_{JK} R_{I,CLDK}$$

CHANNEL I, FIELD OF VIEW J, CLOUD FRACTION α_{JK}

WE USE OBSERVATIONS IN 9 FIELDS OF VIEW TO OBTAIN $\hat{R}_I$

$$\hat{R}_I = \bar{R}_I + \sum_{K=1}^{9} \eta_K \left(\bar{R}_I - R_{I,K}\right) = \bar{R}_i + \sum_{K=1}^{9} \eta_K \Delta R_{I,K}$$

$\bar{R}_I$ = AVERAGE RADIANCE IN 9 SPOTS

UNCONSTRAINED SOLUTION

$$\eta = \left(\Delta R' N^{-1} \Delta R\right)^{-1} \Delta R' N^{-1} \Delta R_{CLR}$$

N = CHANNEL NOISE COVARIANCE MATRIX

$$\Delta R_{CLR} = R_{CLR,I} - \bar{R}_I$$

ΔR_{CLR} IS COMPUTED FROM A STATE THAT AGREES WITH AMSU RADIANCES

TRANSFORMATION OF COORDINATES

DIAGONALIZE $\Delta R' N^{-1} \Delta R$ BY THE TRANSFORMATION U

EQUIVALENT TO SELECTION OF NEW FIELDS OF VIEW $\Delta R^{T} = U \Delta R$

DETERMINE ONE CLOUD FORMATION FOR EACH SIGNIFICANT EIGENVALUE λ_K

FOR kmax SIGNIFICANT EIGENVALUES

$$\hat{R}_{I,CLR} = \bar{R}_I + \sum_{K=1}^{k\,max} \zeta_K \Delta R^{T}_{I,K}$$

WHERE

$$\zeta_K = \lambda_K^{-1} \left(\Delta R^{T'} N^{-1} \Delta R_{CLR} \right)_{K,1}$$

BETTER VALUES OF $R_{I,CLR}$ GIVE BETTER $\hat{R}_{I,CLR}$

$R_{I,CLR}$ SHOULD BE BASED ON AN UNBIASED PROFILE – AGREE WITH AMSU RADIANCES

DANGEROUS TO USE FORECAST GUESS – COULD BE BIASED

OUTLINE OF AIRS RETRIEVAL STEPS

PERFORM MICROWAVE ONLY RETRIEVAL

OBTAIN INITIAL CLEAR COLUMN RADIANCES

ASSIGN CLEAR FLAG

PERFORM AIRS REGRESSION GUESS

PERFORM MICROWAVE RETRIEVAL STARTING FROM AIRS REGRESSION GUESS

OBTAIN UPDATED CLEAR COLUMN RADIANCES

DO AIRS/AMSU RETRIEVALS

OBTAIN FINAL CLEAR COLUMN RADIANCES

REFINE AIRS/AMSU RETRIEVALS

APPLY REJECTION CRITERIA

CURRENT CLEAR FLAG

1) WE LOOK AT EIGENVALUES OF $\Delta R' N^{-1} \Delta R$ AFTER INITIAL CLOUD CLEARING (BEFORE REGRESSION)

   CALL CASE CLOUDY IF $\lambda_{MAX} > \lambda_{THRESHOLD}$

      $\lambda_{THRESHOLD}$ = 80 FOR OCEAN, AND 200 FOR LAND

      ALLOWS FOR MORE SCENE VARIABILITY OVER LAND BECAUSE OF MORE SURFACE VARIABILITY

   THIS DOES NOT INVOLVE PHYSICS AND IS QUICK

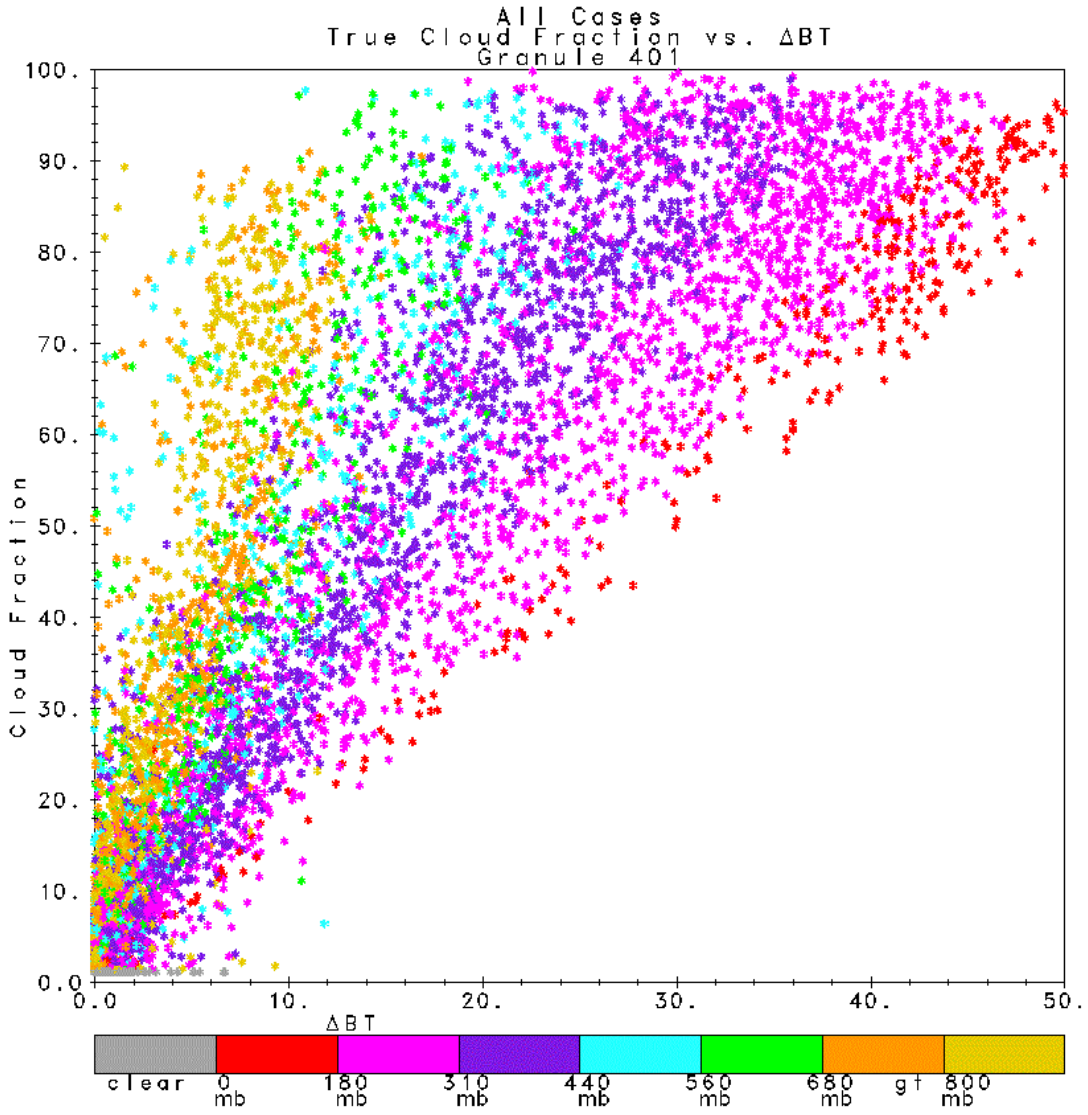
   PROBLEM WITH OVERCAST CASES IF USED ALONE

      NEED TO COMPARE OBSERVED WINDOW RADIANCES WITH VALUES COMPUTED FROM MICROWAVE RETRIEVAL OR DO 2)

2) WE ALSO LOOK AT INITIAL CORRECTION TO CLOUD CLEARED WINDOW RADIANCES (BEFORE REGRESSION)

      ΔBT = AVERAGE VALUE OF $BT_I - BT_I$ FOR CHANNELS BETWEEN 800 cm^{-1} AND 900 cm^{-1}

      CALL CASE CLOUDY IF $|\Delta BT| > 0.1K$
      THIS TEST IS FAST AND IMPROVES REJECTION OF FALSE CLEAR
      THIS IS NOT GOOD FOR STARTUP IDENTIFICATION – INVOLVES PHYSICS



ΔBT

Global mean = 13.52

Variance = 13.12

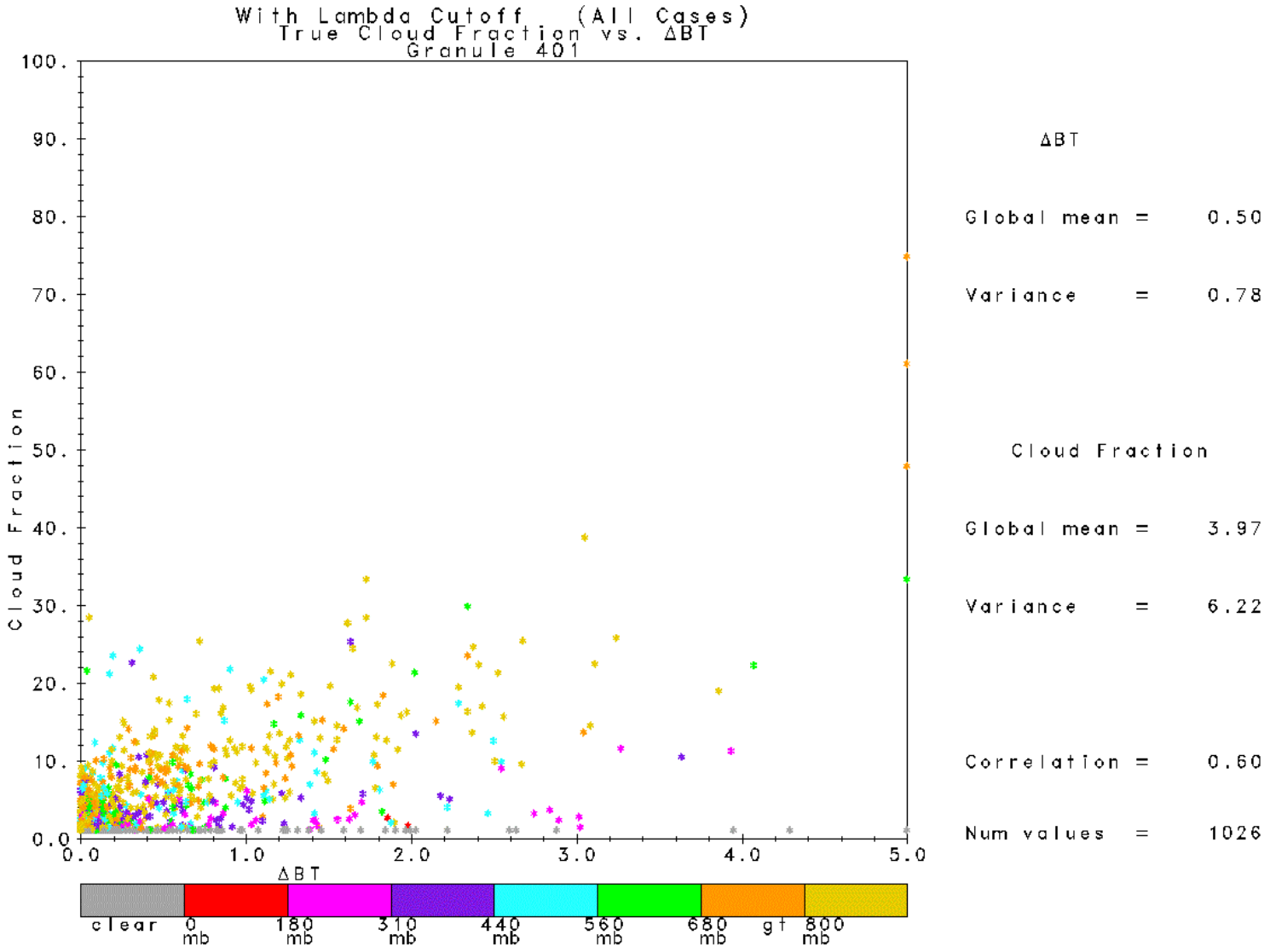
Cloud Fraction

Global mean = 43.22

Variance = 31.75

Correlation = 0.85

Num values = 6976



ΔBT

Global mean = 0.50

Variance = 0.78

Cloud Fraction

Global mean = 3.97

Variance = 6.22

Correlation = 0.60

Num values = 1026

AVERAGE CLOUD FRACTION 1 SCAN LINE PER GRANULE

CASES WHICH ARE "CLEAR" $\alpha_{TRUE} < 2\%$

OCEAN $\lambda < 80$

$\Delta BT < 0.1K$		$\Delta BT < 0.5K$		$\Delta BT < 1K$, NO λ TEST		TOTAL CASES	
NUMBER	$\bar{\alpha}$	NUMBER	$\bar{\alpha}$	NUMBER	$\bar{\alpha}$	NUMBER	$\bar{\alpha}$
219	0.41	273	0.49	339	0.55	354	0.56

CASES WHICH ARE "CLOUDY" $\alpha_{TRUE} > 2\%$

67	4.22	163	5.23	434	6.90	4268	47.75

ALL CASES

286	1.30	436	2.26	773	4.12	4622	43.20

LAND $\lambda < 200$

CASES WHICH ARE CLEAR

109	0.32	196	0.35	293	0.37	363	0.42

CASES WHICH ARE CLOUDY

26	5.04	78	6.45	240	12.23	1997	48.80

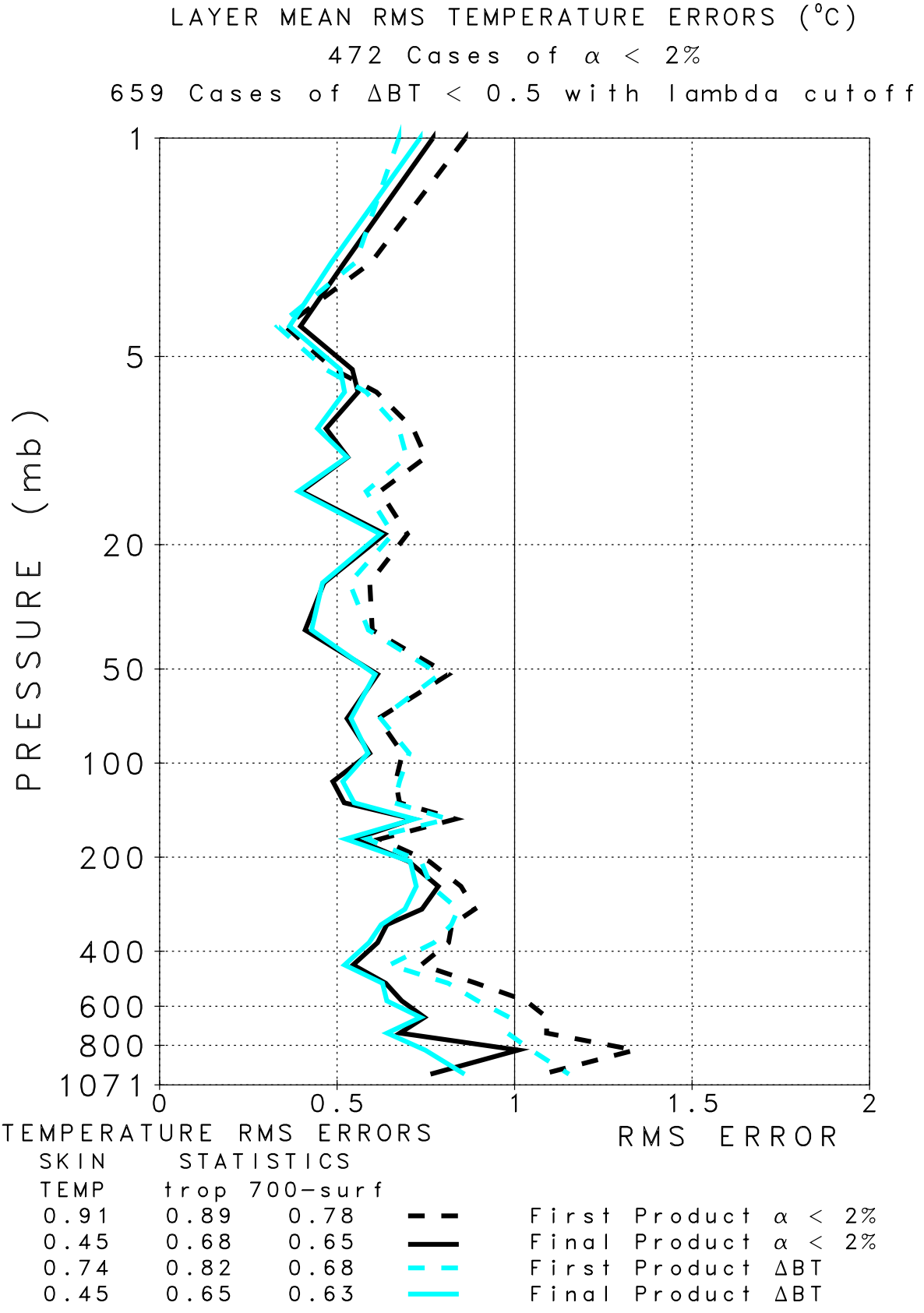
ALL CASES

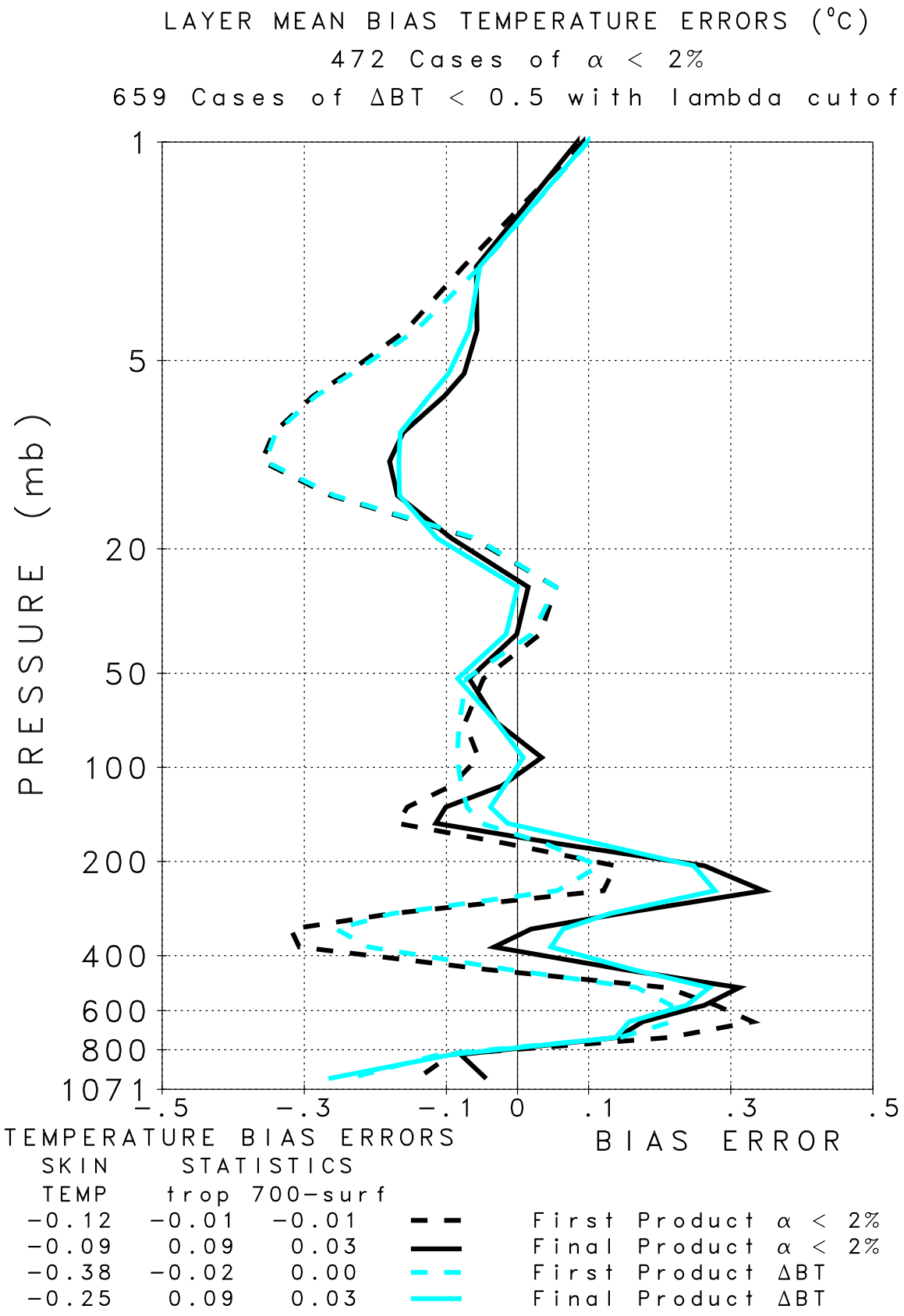
135	1.23	274	2.09	533	5.71	2360	41.36

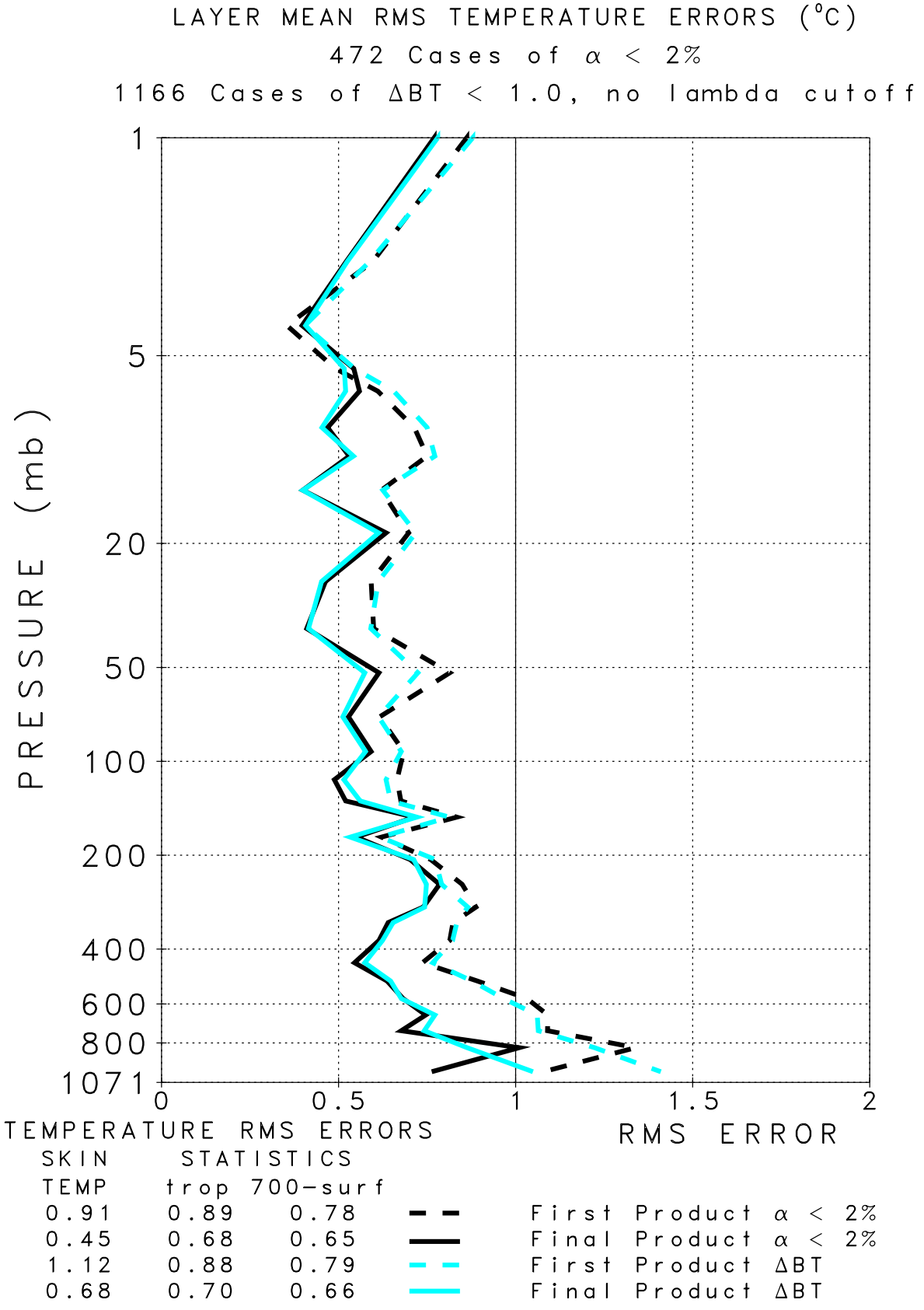
LAND/OCEAN

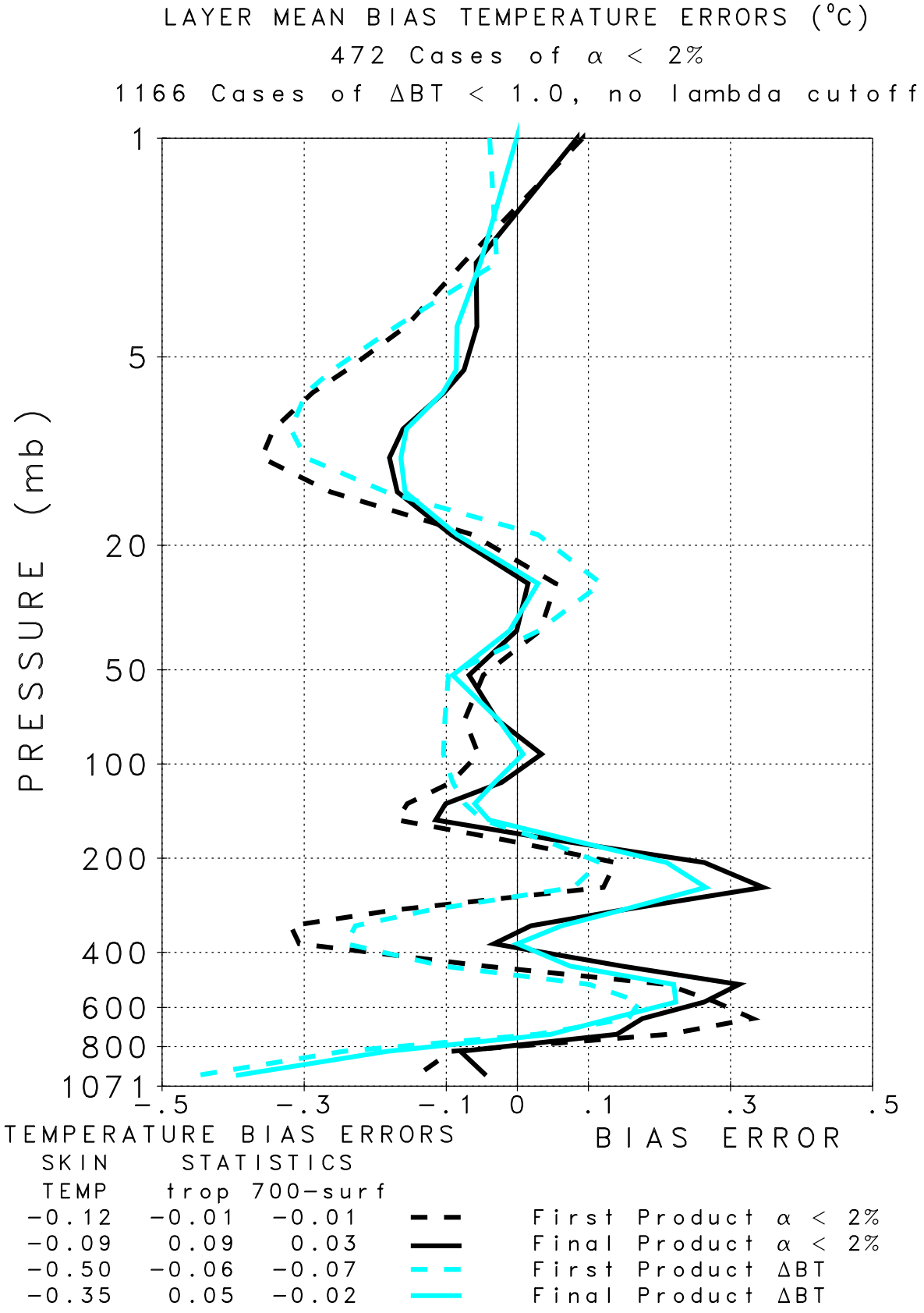
ALL CASES

421	1.28	710	2.20	1306	4.76	6982	43.20


LAYER MEAN RMS TEMPERATURE ERRORS (°C)
472 Cases of α < 2%
659 Cases of ΔBT < 0.5 with lambda cutoff
PRESSURE (mb)
1
5
20
50
100
200
400
600
800
1071
0
0.5
1
1.5
2
RMS ERROR
TEMPERATURE RMS ERRORS
SKIN TEMP
STATISTICS
trop 700-surf
0.91 0.89 0.78
0.45 0.68 0.65
0.74 0.82 0.68
0.45 0.65 0.63
First Product α < 2%
Final Product α < 2%
First Product ΔBT
Final Product ΔBT


LAYER MEAN BIAS TEMPERATURE ERRORS (°C)
472 Cases of α < 2%
659 Cases of ΔBT < 0.5 with lambda cutoff
PRESSURE (mb)
1
5
20
50
100
200
400
600
800
1071
−.5
−.3
−.1
0
.1
.3
.5
BIAS ERROR
TEMPERATURE BIAS ERRORS
SKIN TEMP
STATISTICS trop 700−surf
−0.12 −0.01 −0.01
−0.09 0.09 0.03
−0.38 −0.02 0.00
−0.25 0.09 0.03
First Product α < 2%
Final Product α < 2%
First Product ΔBT
Final Product ΔBT


LAYER MEAN RMS TEMPERATURE ERRORS (°C)
472 Cases of α < 2%
1166 Cases of ΔBT < 1.0, no lambda cutoff
PRESSURE (mb)
1
5
20
50
100
200
400
600
800
1071
0
0.5
1
1.5
2
RMS ERROR
TEMPERATURE RMS ERRORS
SKIN TEMP
STATISTICS
trop
700-surf
0.91 0.89 0.78 First Product α < 2%
0.45 0.68 0.65 Final Product α < 2%
1.12 0.88 0.79 First Product ΔBT
0.68 0.70 0.66 Final Product ΔBT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472 Cases of α < 2%
1166 Cases of ΔBT < 1.0, no lambda cutoff
PRESSURE (mb)
1
5
20
50
100
200
400
600
800
1071
−.5
−.3
−.1
0
.1
.3
.5
BIAS ERROR
TEMPERATURE BIAS ERRORS
SKIN TEMP
STATISTICS
trop
700−surf
−0.12
−0.01
−0.01
−0.09
0.09
0.03
−0.50
−0.06
−0.07
−0.35
0.05
−0.02
First Product α < 2%
Final Product α < 2%
First Product ΔBT
Final Product ΔBT

SUMMARY

CLEAR FLAG ALGORITHM WORKS EXTREMELY WELL

RETRIEVALS ARE COMPARABLE TO CASES WHERE THE TRUTH IS “CLEAR”
$\alpha < 2\%$

TIGHT TEST REQUIRES PHYSICS – NOT APPLICABLE UNTIL WE KNOW SRF’S

NEAR CLEAR RETRIEVALS ARE VERY ACCURATE

ROUGHLY 20% OF THE CASES

$\bar{\alpha} < 5\%$

WE PRODUCE CLEAR COLUMN RADIANCES FOR ASSIMILATIONS TO USE

METHOD IS QUICK AND DOES NOT REQUIRE A FULL RETRIEVAL

WE ENCOURAGE USERS TO TEST OUR CLEAR COLUMN RADIANCES